



## Challenges for innovation in the maritime industry

**Perunovic, Zoran; Fürstenberg, Sofia ; Christoffersen, Mads**

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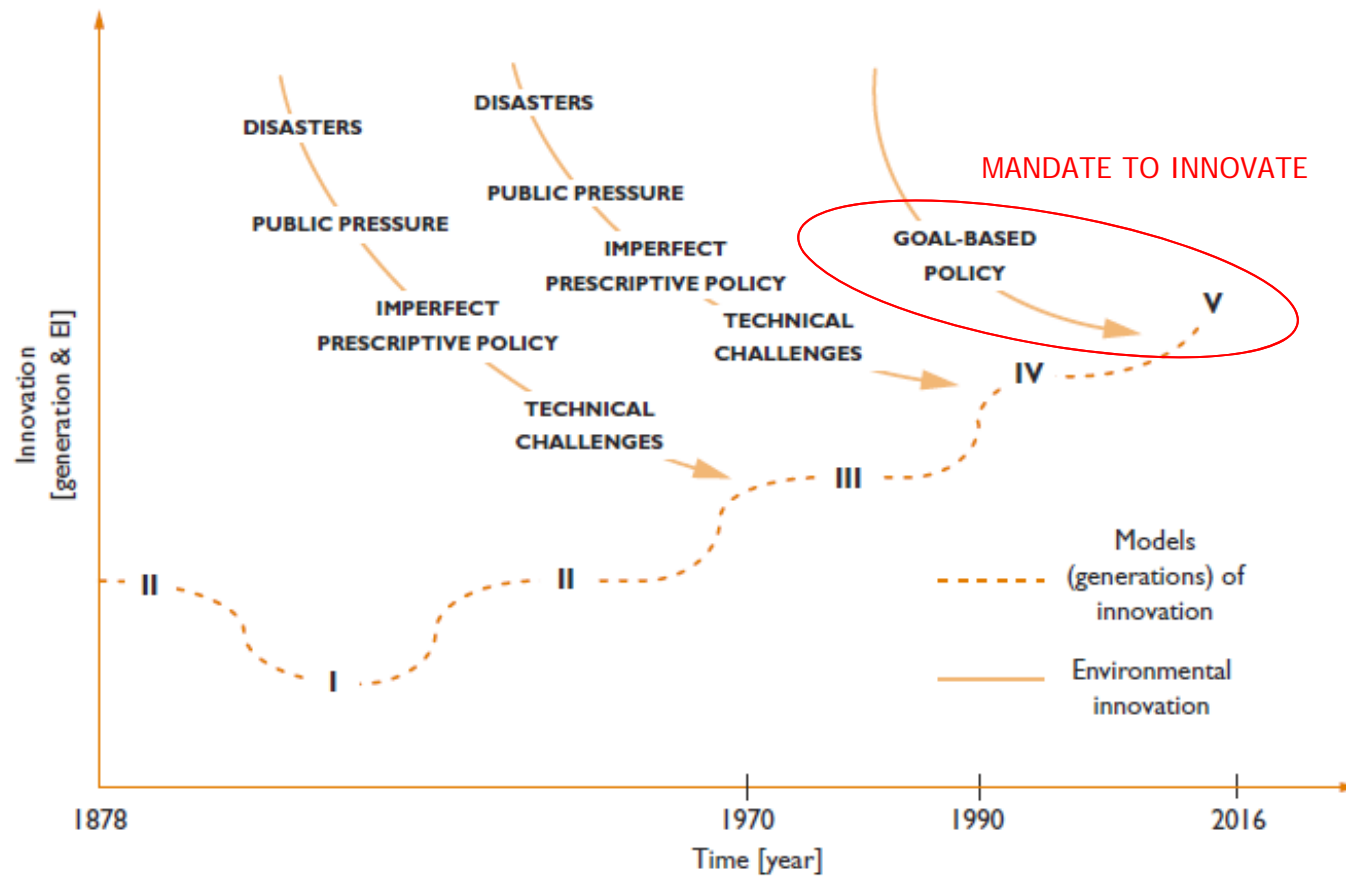
# CHALLENGES

## for Innovation in Networks in the Maritime Industry

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Zoran Perunovic, Technical University of Denmark  
Sofia Furstenberg, AP Moller-Maersk  
Mads Christoffersen, Technical University of Denmark

# Innovation dynamics in the maritime industry



Perunovic and Vidic-Perunovic (2012)

# Research sponsored by the Danish Maritime Fund

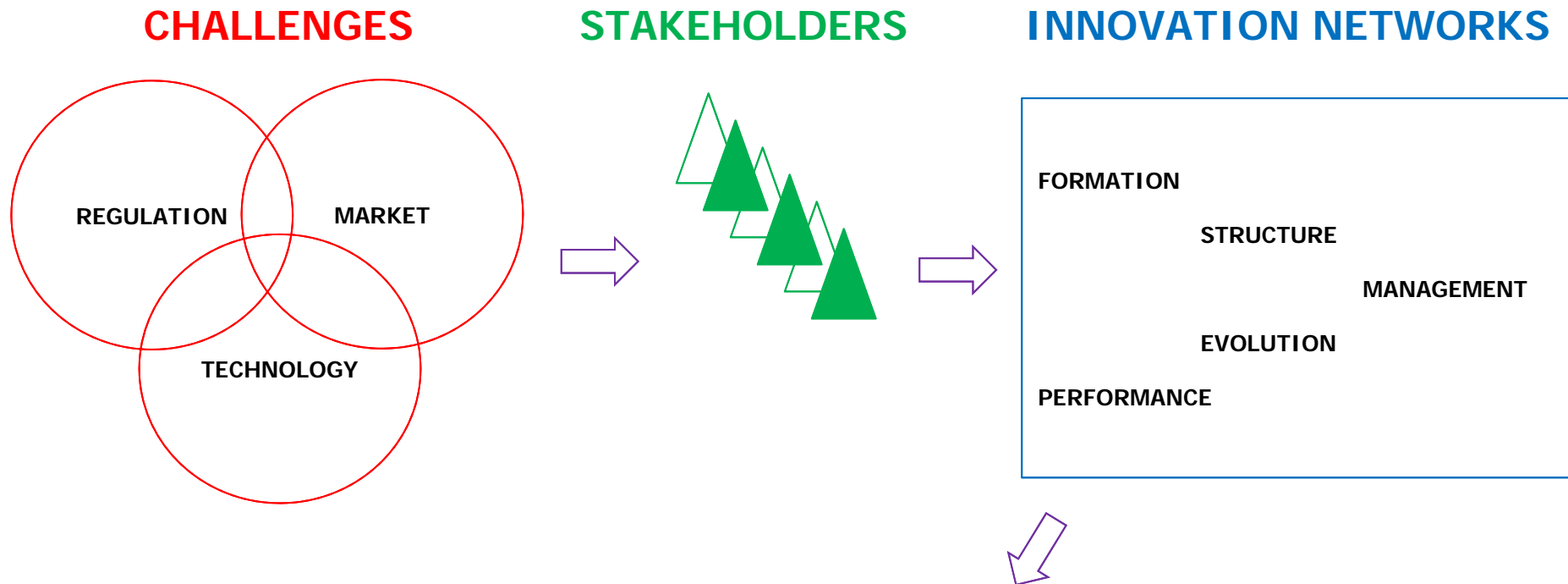
## Research objectives

- Determine the **key enablers, barriers, and mechanisms** of “innovation in networks” in the maritime industry
- Identify the key **characteristics of collaborative innovation processes** applied in the maritime industry
- Determine **managerial actions** to be undertaken to organize for successful innovation in networks
- **Asses the benefits** of innovation in networks

## Research strategy

- Multiple-case research strategy

# Research design



**Explanation of how “innovation in networks” creates value for participants in the maritime industry**

# Regulatory requirements



**Air pollution reduction**  
SO<sub>x</sub>, NO<sub>x</sub>, PM, CO<sub>2</sub>



**Ballast Water  
Treatment**

Outside an ECA established to limit SOx and particulate matter emissions	Inside an ECA established to limit SOx and particulate matter emissions
4.50% m/m prior to 1 January 2012	1.50% m/m prior to 1 July 2010
3.50% m/m on and after 1 January 2012	1.00% m/m on and after 1 July 2010
0.50% m/m on and after 1 January 2020*	0.10% m/m on and after 1 January 2015

■ Existing  
■ Possible future ECA

\* May be pushed to 2025. Decision in 2018 or earlier

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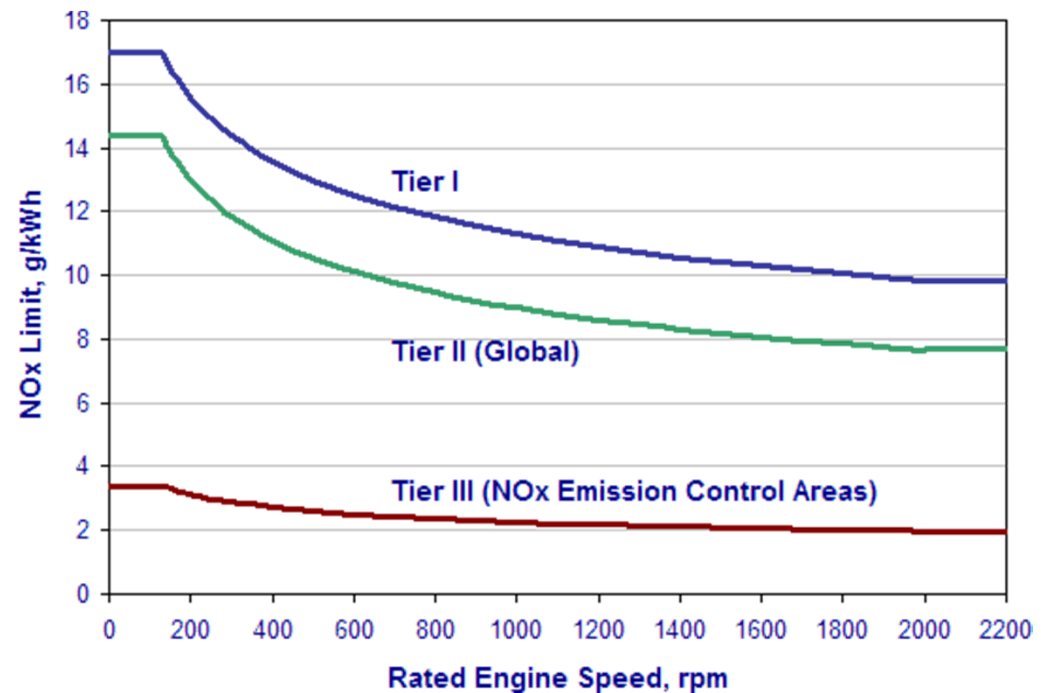
# Regulatory requirements

## NOx reduction

Tier	Ship construction date on or after	Total weighted cycle emission limit (g/kWh) n = engine's rated speed (rpm)		
		n < 130	n = 130 – 1999	n ≥ 2000
I	1 January 2000	17.0	$45.n-0.2$ e.g., 720 rpm – 12.1	9.8
II	1 January 2011	14.4	$44.n-0.23$ e.g., 720 rpm – 9.7	7.7
III	1 January 2016	3.4	$9.n-0.2$ e.g., 720 rpm – 2.4	2.0

Tier III enforcement date (January 2016) is being debated. US and Canada will implement 2016. Other and new ECA still uncertain.

Major engine conversion could shift compliance from Tier I to Tier II





# Regulatory requirements

## Greenhouse gasses

Vessel type	Size	Phase 0 2013 – 2014	Phase 1 2015 - 2019	Phase 2 2020 - 2024	Phase 3 2025 -
Bulk carriers	>20,000 dwt	0%	10%	20%	30%
	10-20,000 dwt	n/a	0-10%	0-20%	0-30%
Gas tankers	>10,000 dwt	0%	10%	20%	30%
	2-10,000 dwt	n/a	0-10%	0-20%	0-30%
Tanker and combination carriers	>20,000 dwt	0%	10%	20%	30%
	4-20,000 dwt	n/a	0-10%	0-20%	0-30%
Container ships	>15,000 dwt	0%	10%	20%	30%
	10-15,000 dwt	n/a	0-10%	0-20%	0-30%
General cargo	>15,000 dwt	0%	10%	15%	30%
	3-15,000 dwt	n/a	0-10%	0-15%	0-30%
Refrigerated cargo	>5,000 dwt	0%	10%	15%	30%
	3-5,000 dwt	n/a	0-10%	0-15%	0-30%

### Market-based, operational, and technical measures proposed

Energy Efficiency Design Index (EEDI)

$$EEDI = \frac{CO_2 \text{ emission}}{\text{transport work}}$$

Ship Energy Efficiency Management  
Plan (SEEMP)

Energy Efficiency Operational Indicator (EEOI)

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# Regulatory requirements

## Ballast water treatment

Year constructed	BW Capacity (m <sup>3</sup> )	Applicability of standards	New schedule
Before 2009	1,500 - 5,000	D-1 or D-2 before end of 2014. D-2 from 2015	1 <sup>st</sup> renewal survey after entry into force of the Convention
Before 2009	Less than 1,500 or greater than 5,000	D-1 and D-2 before end of 2016. D-2 from 2017	1 <sup>st</sup> renewal survey after the anniversary date of delivery of ship in 2016
In 2009 or after	Less than 5,000	D-2	1 <sup>st</sup> renewal survey after entry into force of the Convention
Between 2009 and 2012	5,000 or more	D-1 and D-2 before end of 2016. D-2 from 2017	1 <sup>st</sup> renewal survey after the anniversary date of delivery of ship in 2016
In 2012 or after	5,000 or more	D-2	1 <sup>st</sup> renewal survey after entry into force of the Convention

← IMO

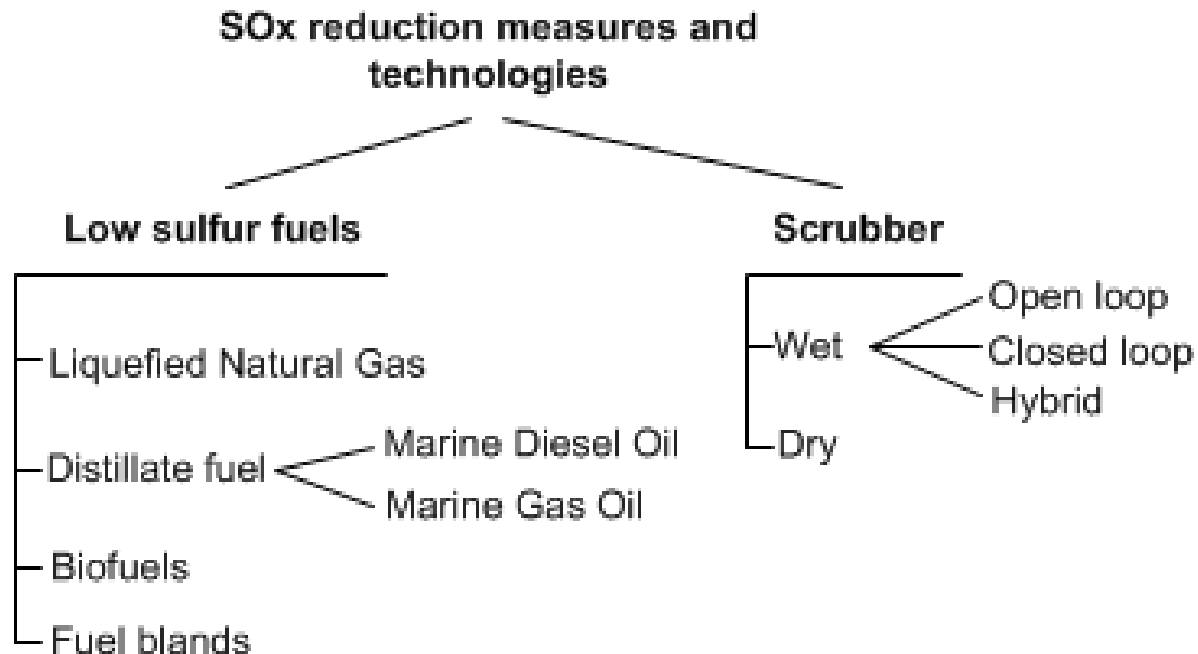
Vessel type	BW capacity	Date constructed	Vessel's compliance date
New	All	On or after 1 December 2013	On delivery
Existing	Less than 1500 m <sup>3</sup>	Before 1 December 2013	First scheduled drydocking after 1 January 2016
Existing	1500 - 5000 m <sup>3</sup>	Before 1 December 2013	First scheduled drydocking after 1 January 2014
Existing	Greater than 5000 m <sup>3</sup>	Before 1 December 2013	First scheduled drydocking after 1 January 2016

← US

**IMO postponed – US will start**  
**Different requirements for approval of systems**  
**50+ different systems**

# Technologies

## SOx reduction



Engine modifications required

Lengthy installation process

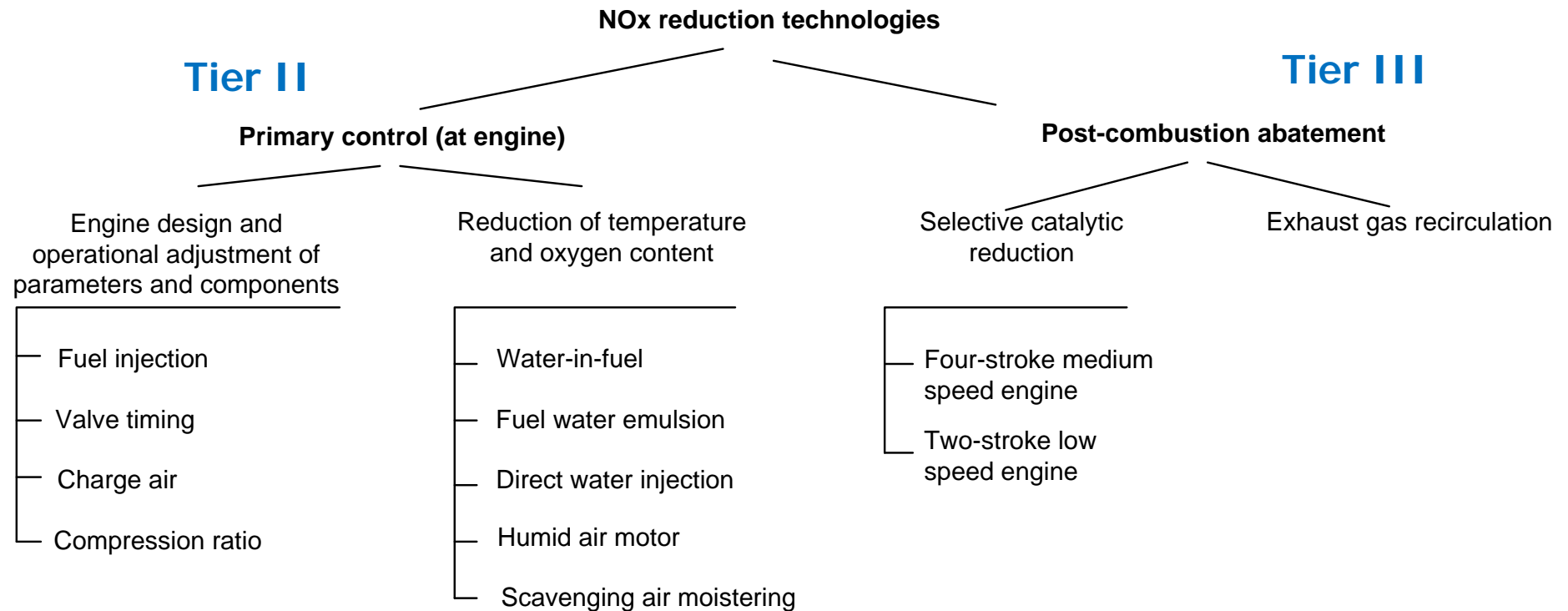
LNG not effective for retrofitting

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# Technologies

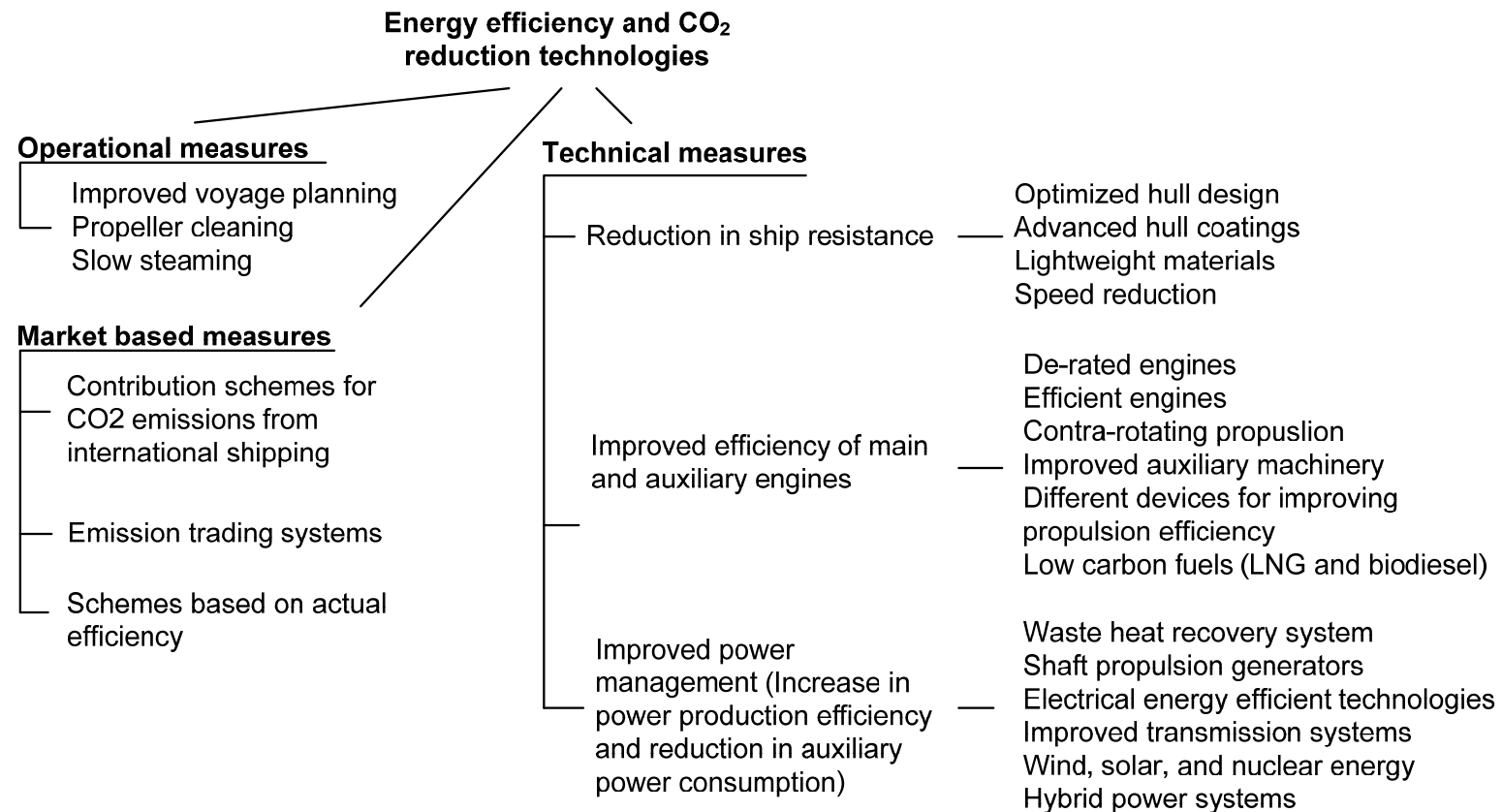
## NOx reduction



**Negative correlation between fuel combustion efficiency and NOx emission**

# Technologies

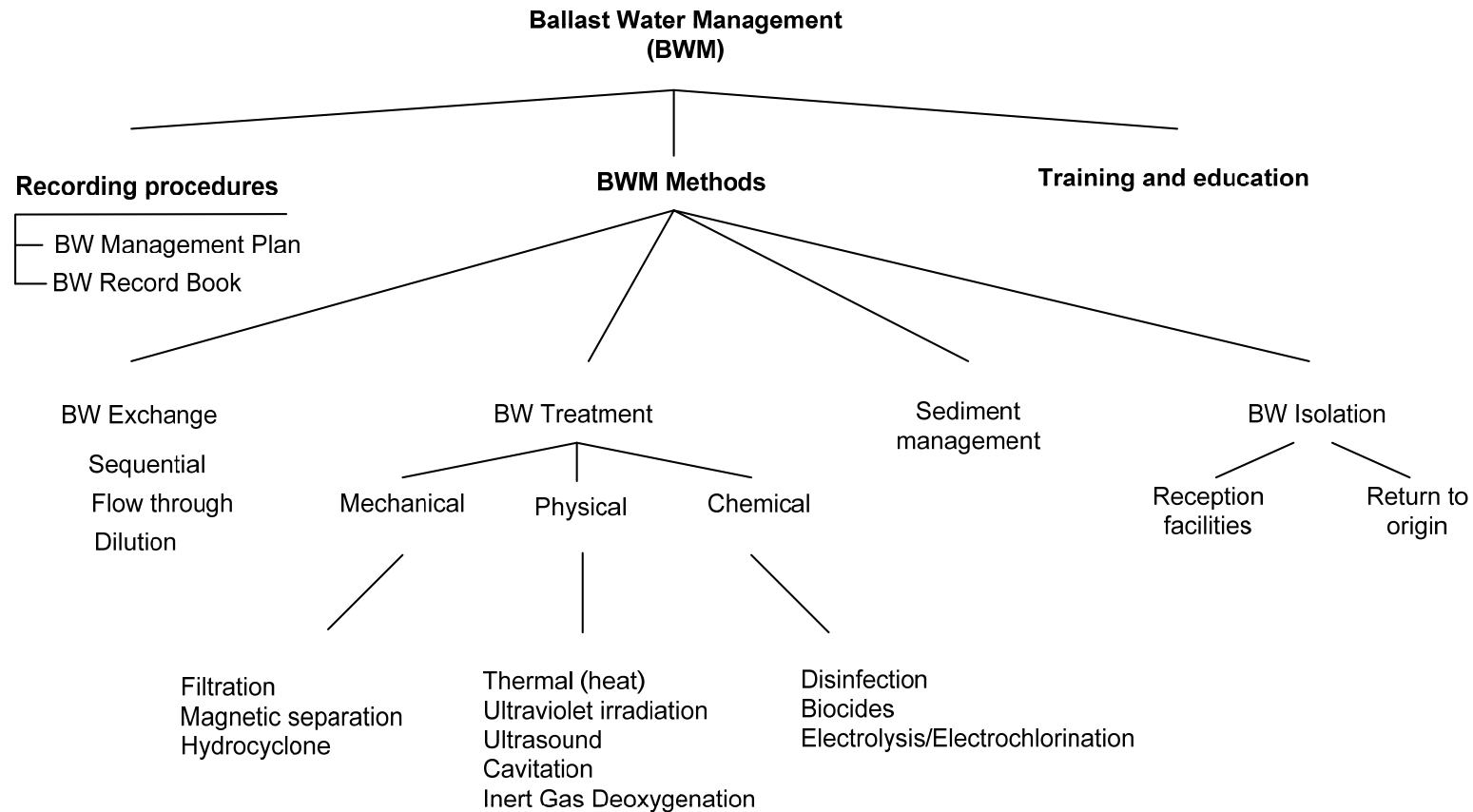
## Energy efficiency and CO<sub>2</sub> reduction



## Retrofit vs Newbuild

# Technologies

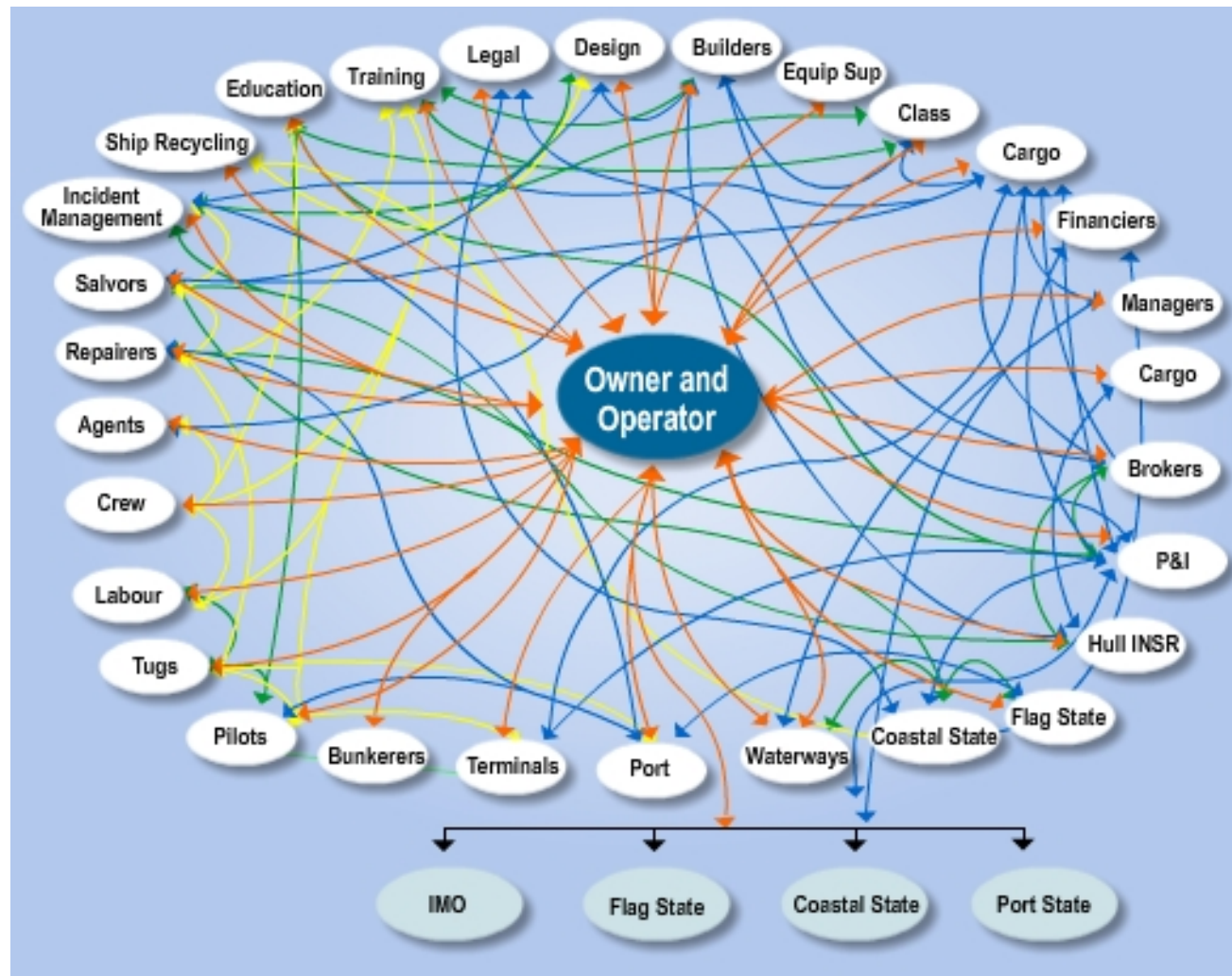
## Ballast water treatment



# Market challenges

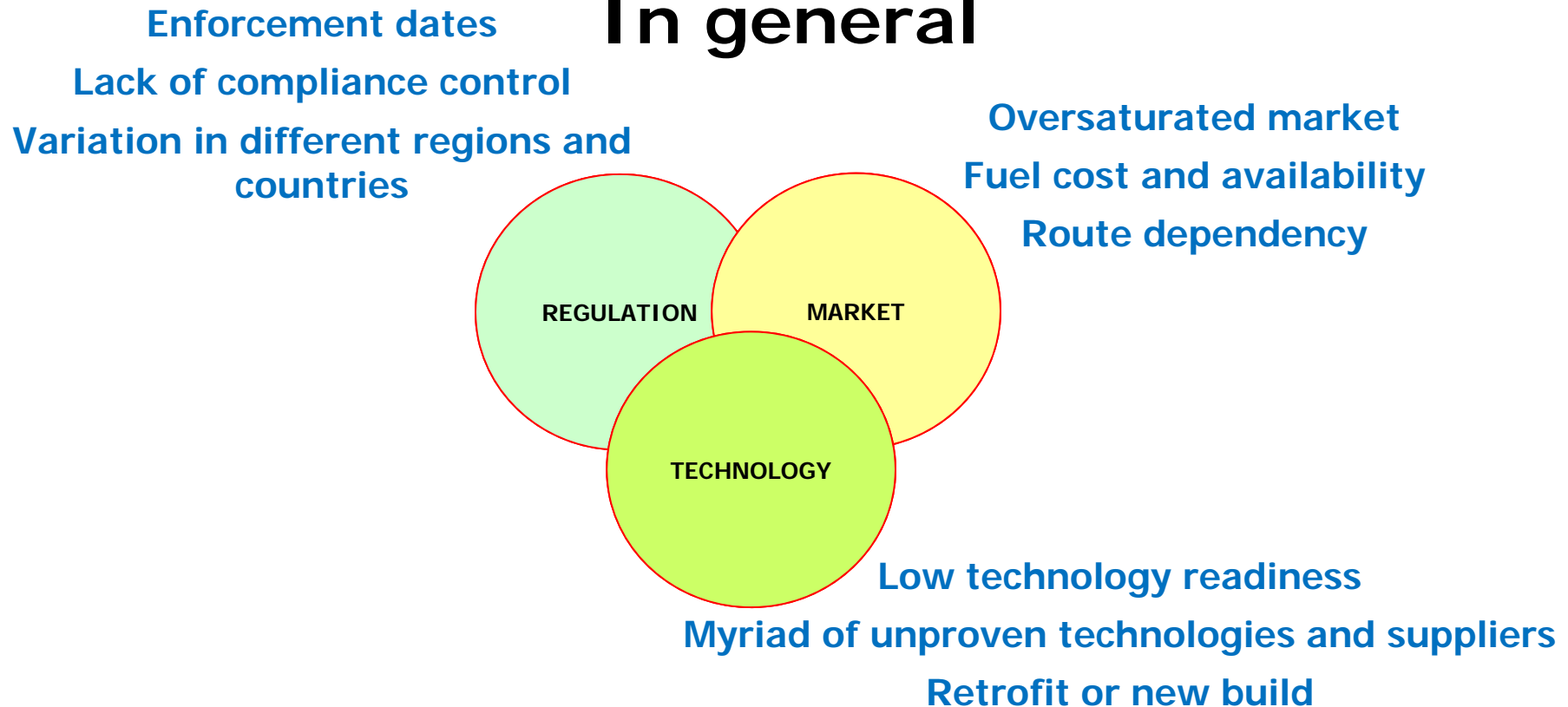
- Fleet over-capacity creates low freight rates and aggressive competition
- Price development of HFO vs. other fuel options such as LNG, is very difficult to predict, and the outcome will have tremendous effect on the business case for the different options
- Market is growing North-South rather than East-West, with different trade of goods, and thus different types of ships. Hence, obsolete vessels on e.g. Asia-Europe trade cannot easily be transferred to Europe-South America
- Ships being built today have an expected life-time of 25 years. Regulatory landscape will look different by then, but many solutions are irreversible – hence placing the bet on LNG is not something you can go and change

# Stakeholders

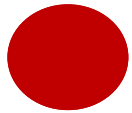




# In general



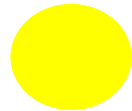
# Innovation networks



Owner driven



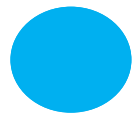
Vertical engine maker-driven



Horizontal engine maker-driven



Participant driven informal

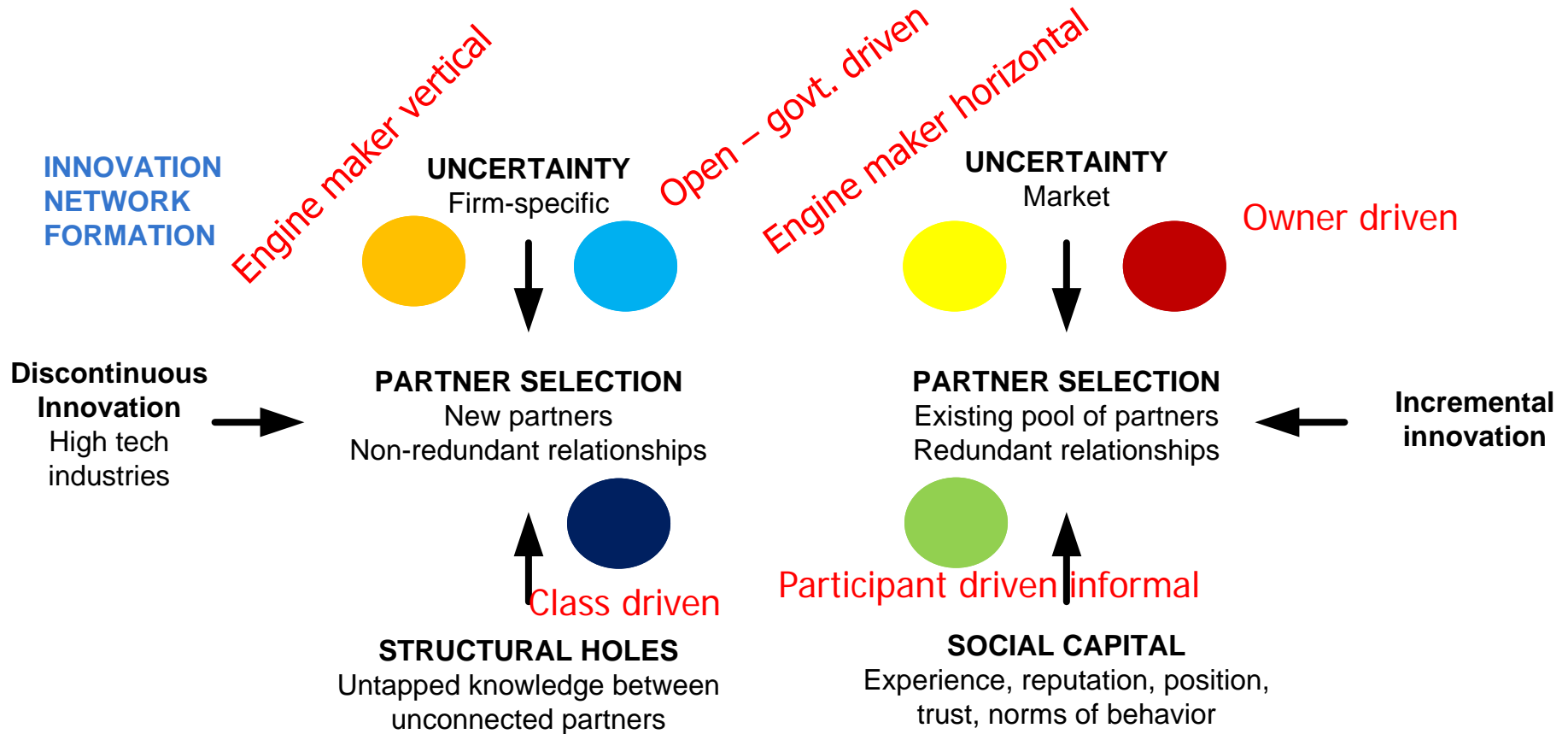


Open networks (government driven)



Classification society driven decentralized networks

# Formation



## Key enablers

Good network management  
Absorptive capacity

## Key barriers

Social capital mind set  
Lack of innovation stimulating organizational culture  
Use of innovative products and solutions in operations

## Opportunity

Structural holes between technology suppliers  
Horizontal networks among owners and technology suppliers